The “Lizard Whisperer”

Energetics

Outline

- Ectotherms energetics
- Obtaining oxygen
- Circulation

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Consequences of endothermy

- Ectotherms are energy efficient

Consequences of endothermy

- Example: Hubbard Brook ecosystem
- 90% of salamanders: *Plethodon cinereus*
- Consumption: 46000 kJ / Ha
- (Bird consumption: 209000 kJ / Ha)
- Production: 46000 * 0.6 = 27600 kJ / Ha
- (Bird production: 209000 * 0.01 = 2090 kJ / Ha)

Outline

- Endotherm energetics
- Obtaining oxygen
- Circulation

Gas Exchange and Circulation

- Herps obtain oxygen from the environment and transport it to their tissues
- The details of how this occurs differs drastically among the major groups of herps

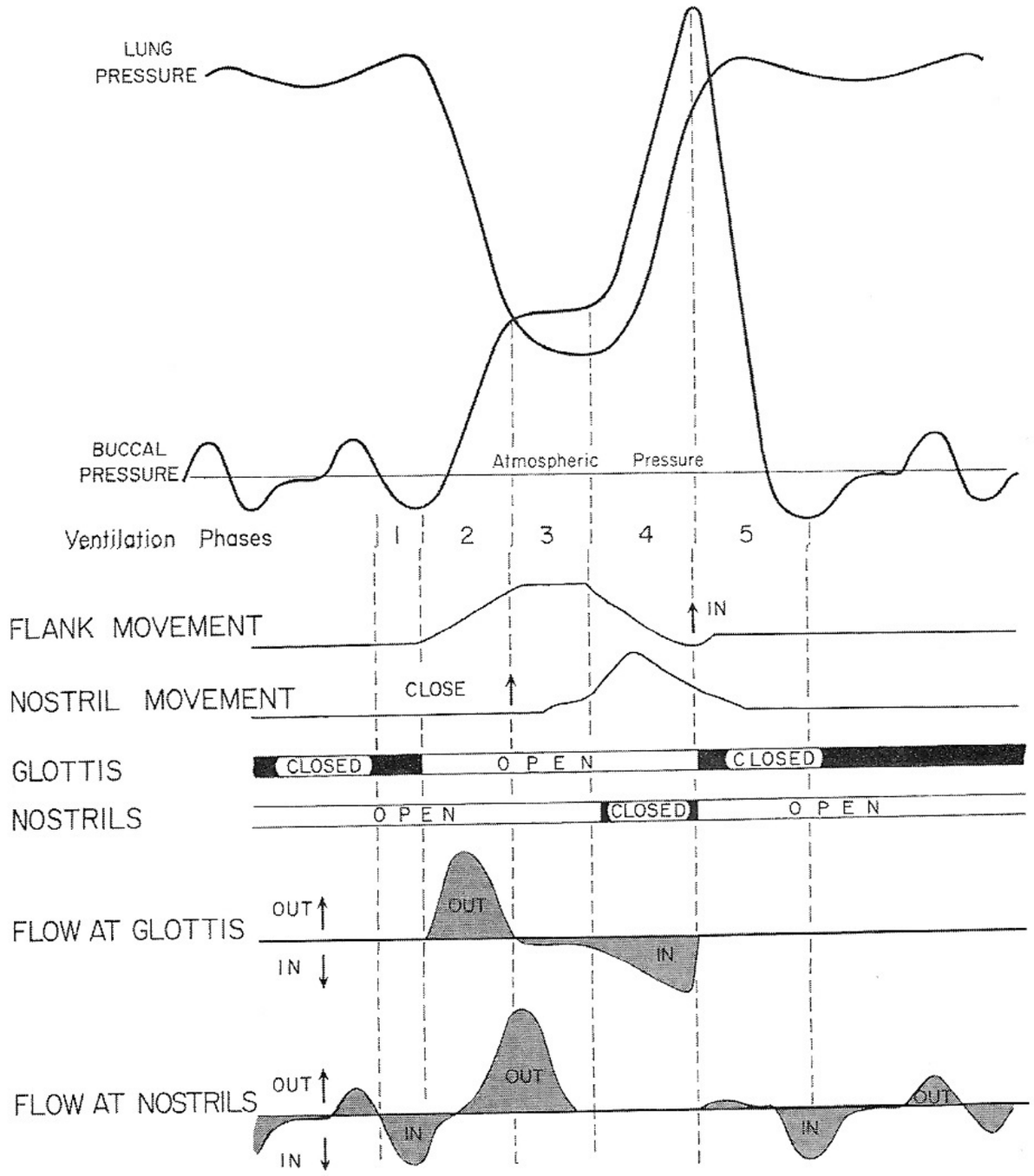
Gas Exchange

- Gas exchange can occur through air or water
- Many amphibians and some reptiles can use both
- Pulmonary gas exchange: through the lungs
- Nonpulmonary gas exchange: through other body parts

Amphibian lungs

- **Buccal pumping**: a system of ventilation where air is forced into the lungs by positive pressure in the buccal region
- Mechanism of breathing in all amphibians

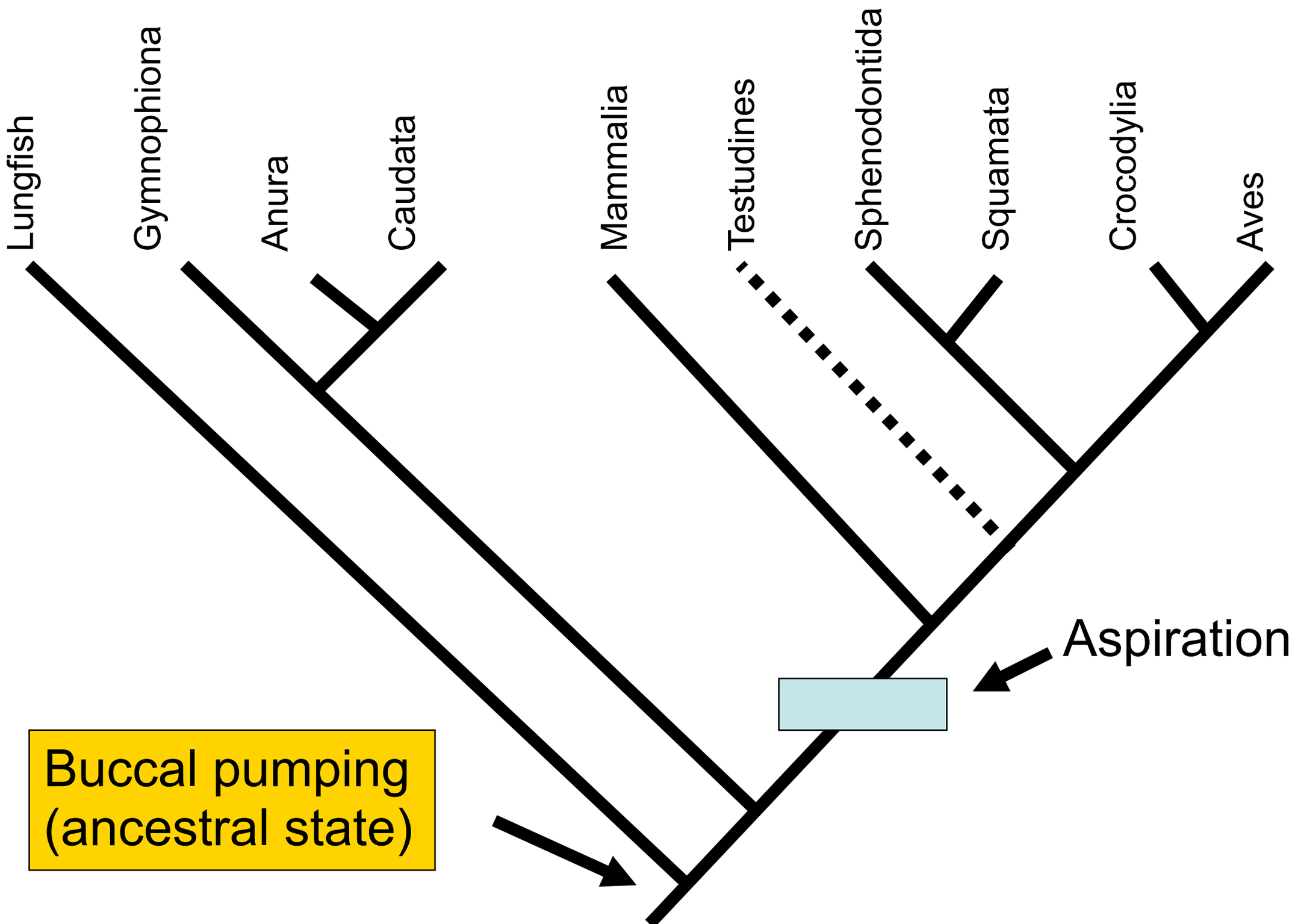
Amphibian lungs



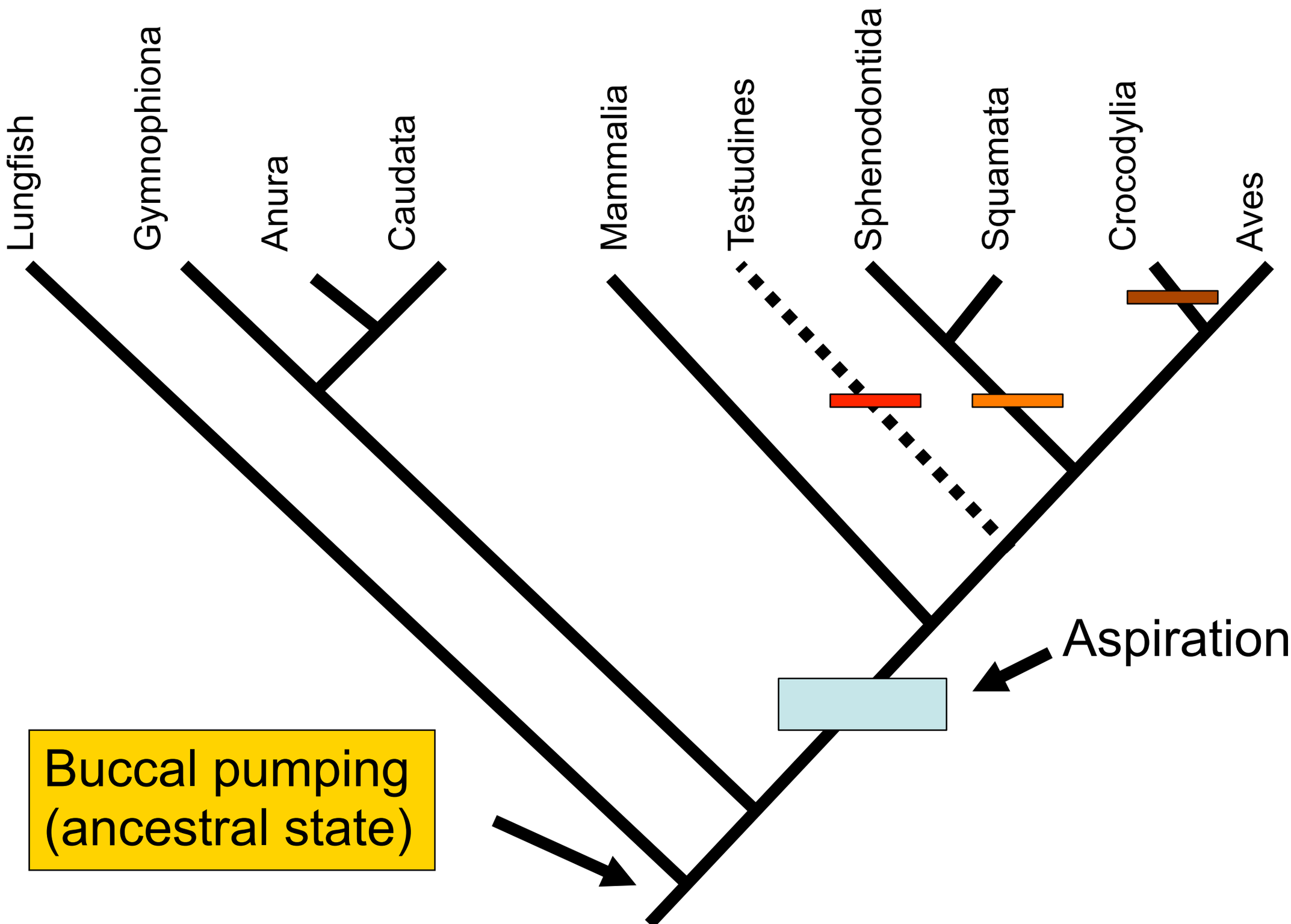
Reptile lungs

- **Aspiration**: A system of breathing where air is forced into the lungs by negative pressure within the lungs
- Reptiles (including birds), mammals

Respiration

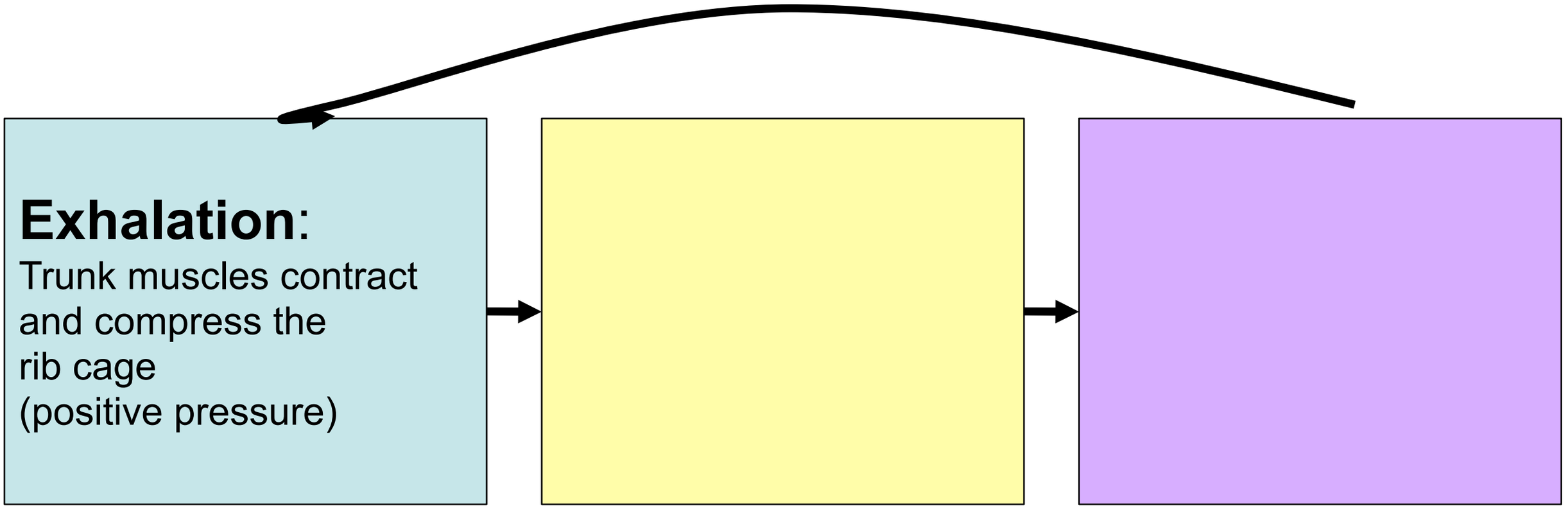


Respiration



Breathing in squamates

- Pressure within the lungs is controlled through contraction of trunk muscles
- Three stages



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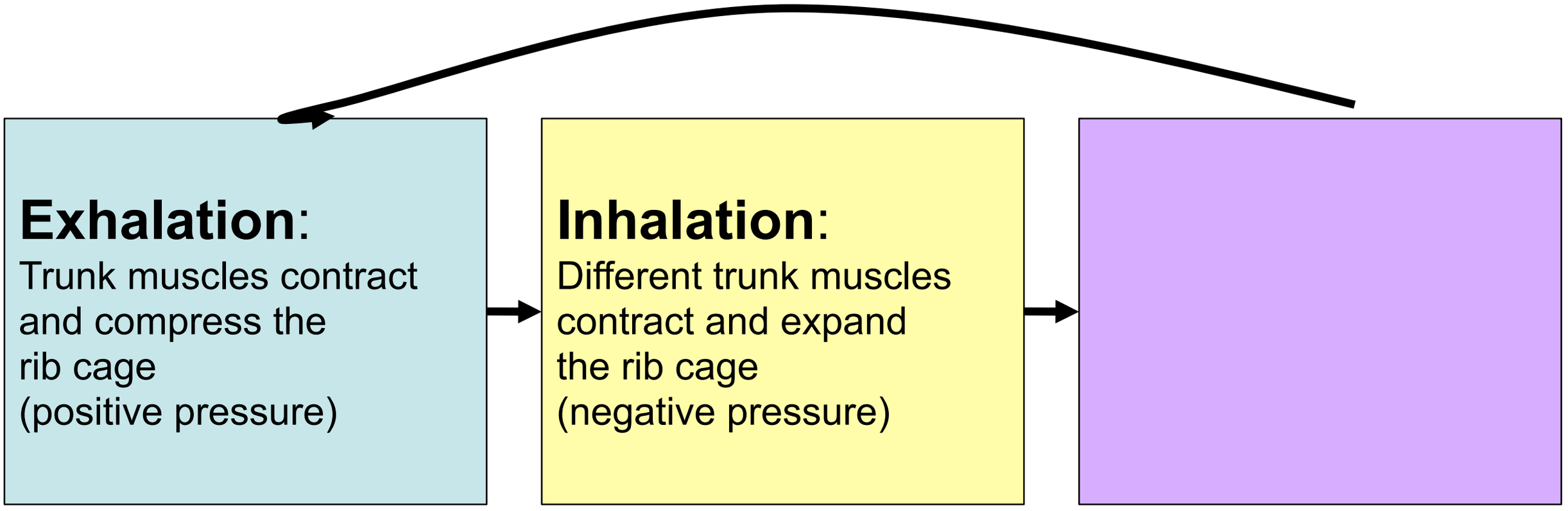

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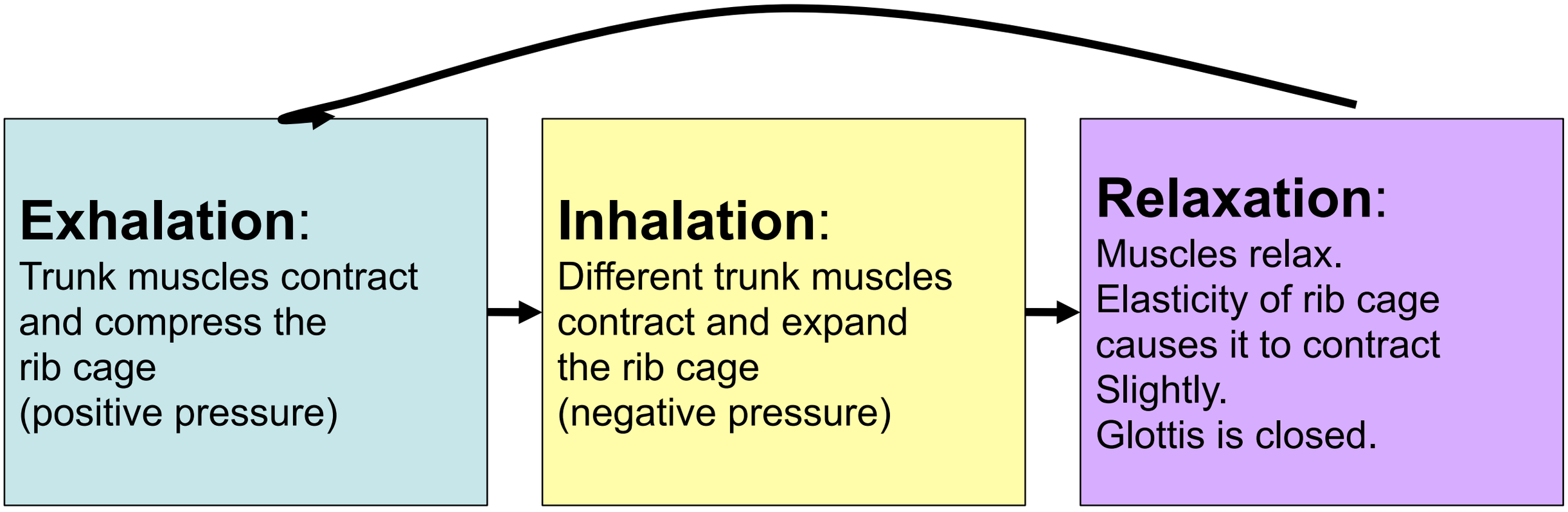

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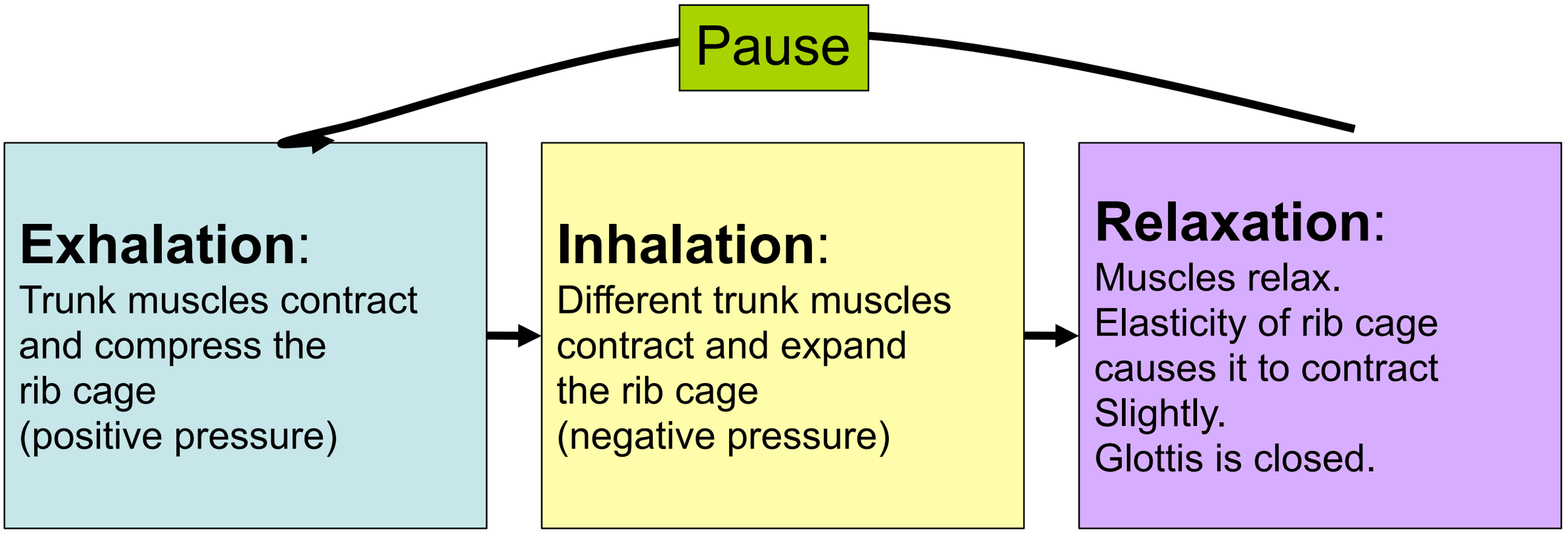
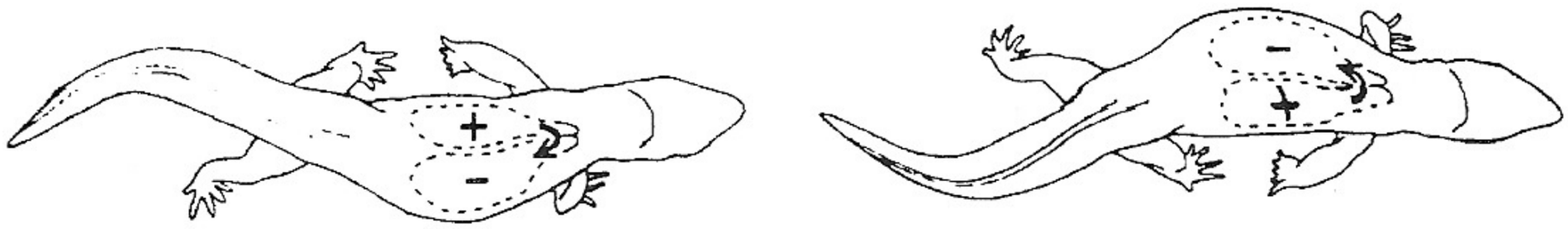


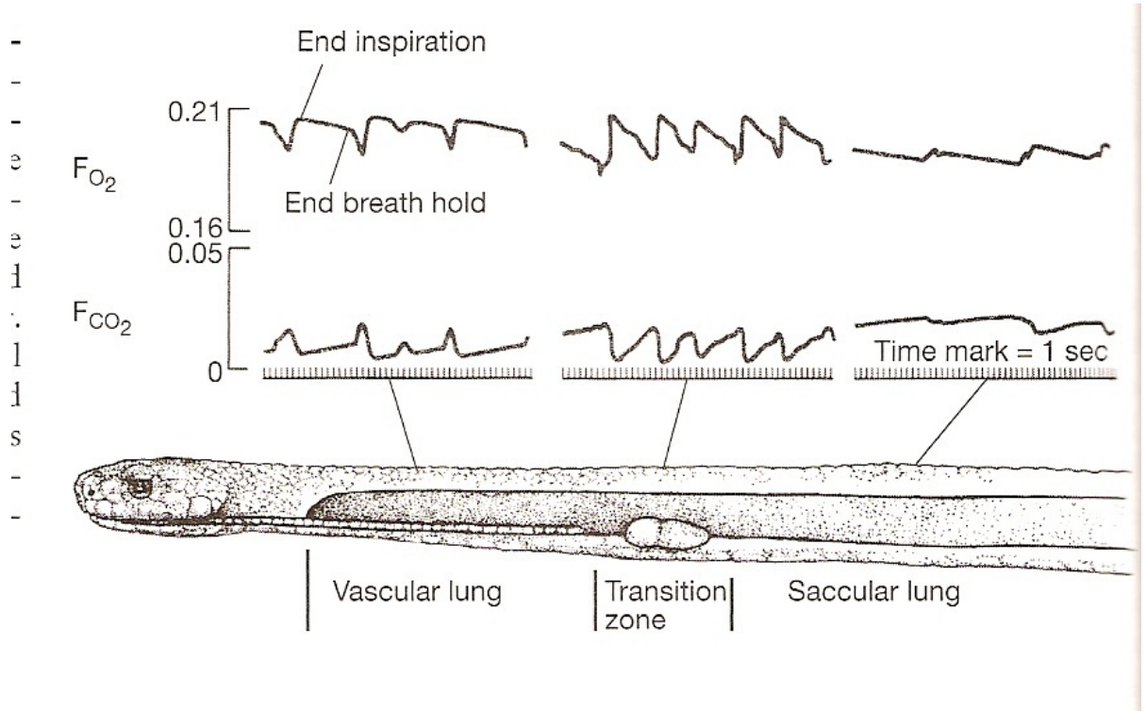
Breathing in squamates

- Lizards can’t run and breathe at the same time (except varanids)



Lung reduction in snakes

- Snakes have greatly reduced left lungs
- Right lung has two regions



Breathing in crocodilians

- Trunk muscles don’t play a major role
- Use liver as a “plunger” that compresses and expands the lungs

Breathing in turtles

- Problem: thoracic cavity enclosed in hard shell
- Rib movement is impossible
- Breathe using their visceral cavity

Breathing in turtles

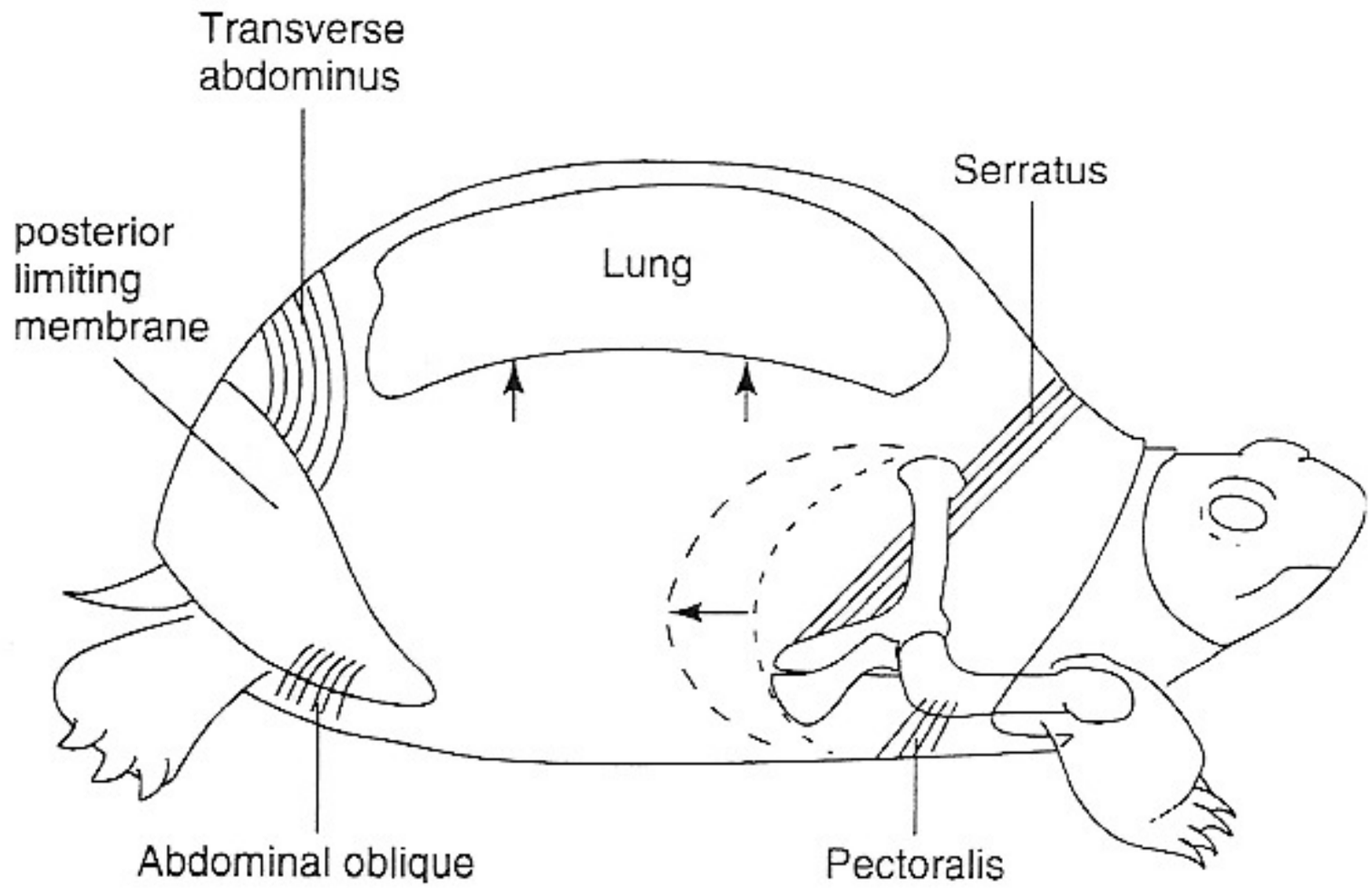


Figure 7–7 **Schematic view of the lungs and respiratory**

Gas Exchange

- Gas exchange can occur through air or water
- Many amphibians and some reptiles can use both
- Pulmonary gas exchange: through the lungs
- Nonpulmonary gas exchange: through other body parts

Nonpulmonary gas exchange

- Skin, gills, pharynx, buccal region, and cloaca all can serve as sites for gas exchange
- Permiability to water is inseperable from permiability to O_2 and CO_2
- Nonpulmonary gas exchange is more common in amphibians than reptiles
- Adult amphibians do have lungs, but in aquatic species these are mainly for buoyancy

Nonpulmonary gas exchange

- Plethidontidae (lungless salamanders) exchange gases in the buccal region of the throat

Hydromantes platycephalus

Nonpulmonary gas exchange

- Some aquatic amphibians have elaborate skin folds to increase surface area for respiration

Hairy frog

Trichobatrachus robustus

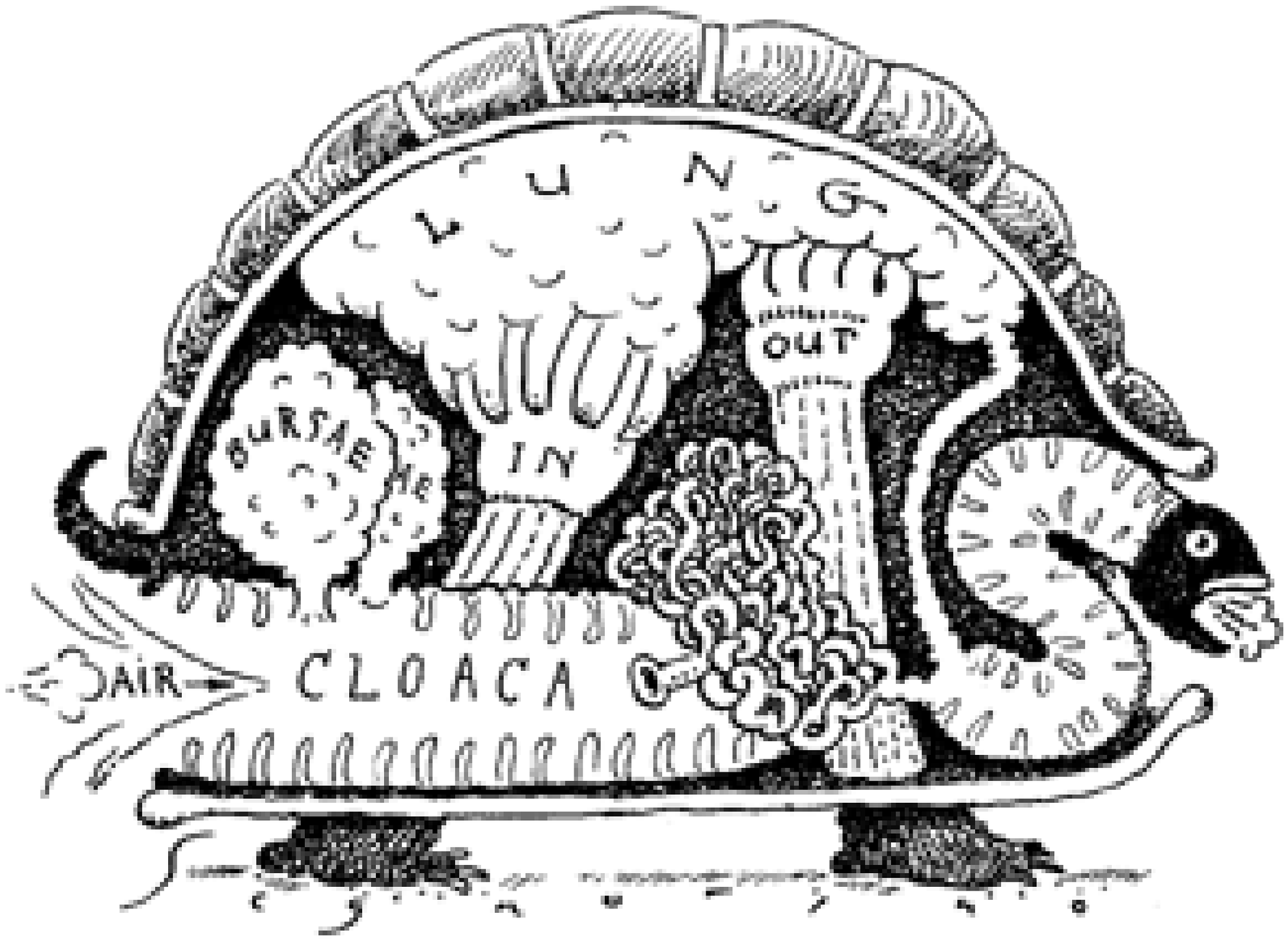
Nonpulmonary gas exchange

- All larval aquatic amphibians have gills
- Some paedomorphic salamanders retain gills as adults
- Gills are filamentous structures supported by water and highly vascularized

Nonpulmonary gas exchange

- Some reptiles have significant nonpulmonary gas exchange
- Examples:
  - Sea snakes - across skin
  - Aquatic turtles - pharnyx, cloaca

Nonpulmonary gas exchange



http://www.straightdope.com/columns/011116.html

Elseya albagula - a newly described species of bimodally respiring freshwater turtle.

The cloaca of bum-breathing turtles actively pumps water in and out to extract oxygen.

http://www.uq.edu.au/eco-lab/bimodal-respiration-in-turtles

Outline

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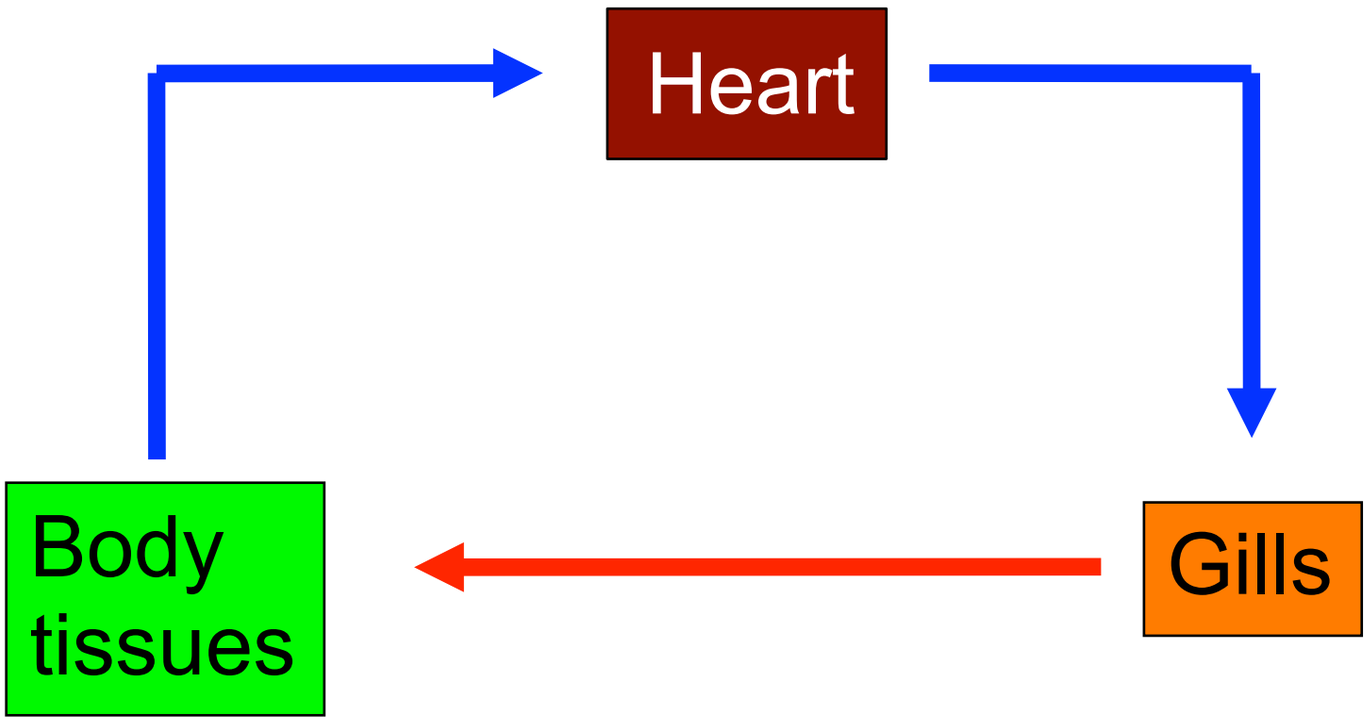
- Obtaining oxygen
- Circulation

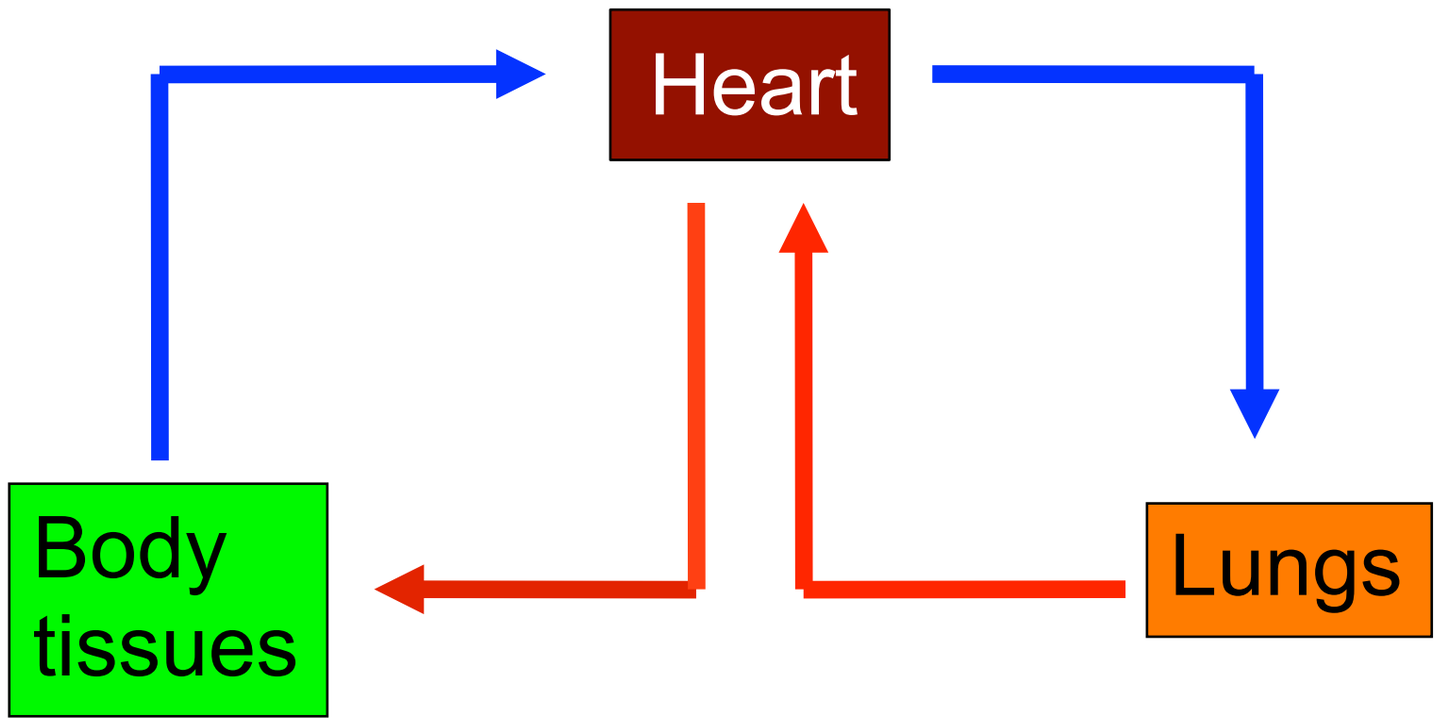
Circulation

- Animals with gills: simple loop



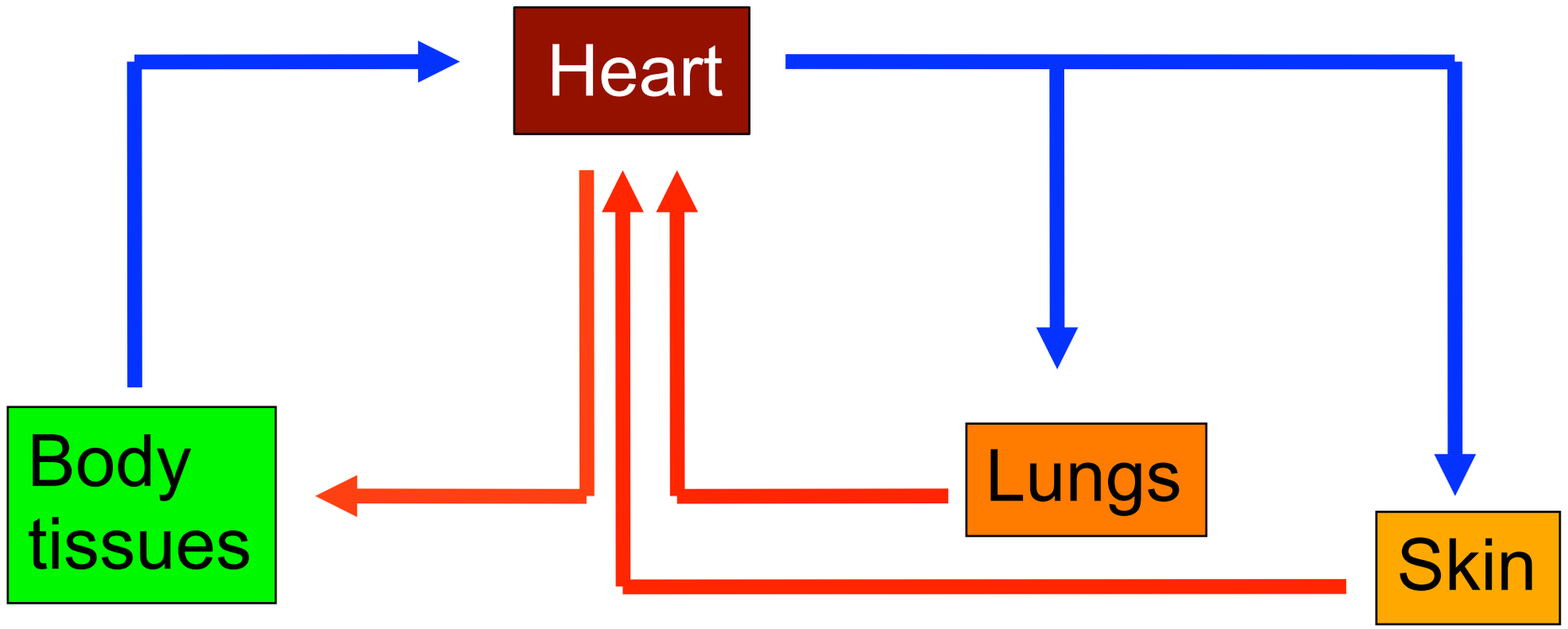
Circulation

- Animals with lungs: figure eight



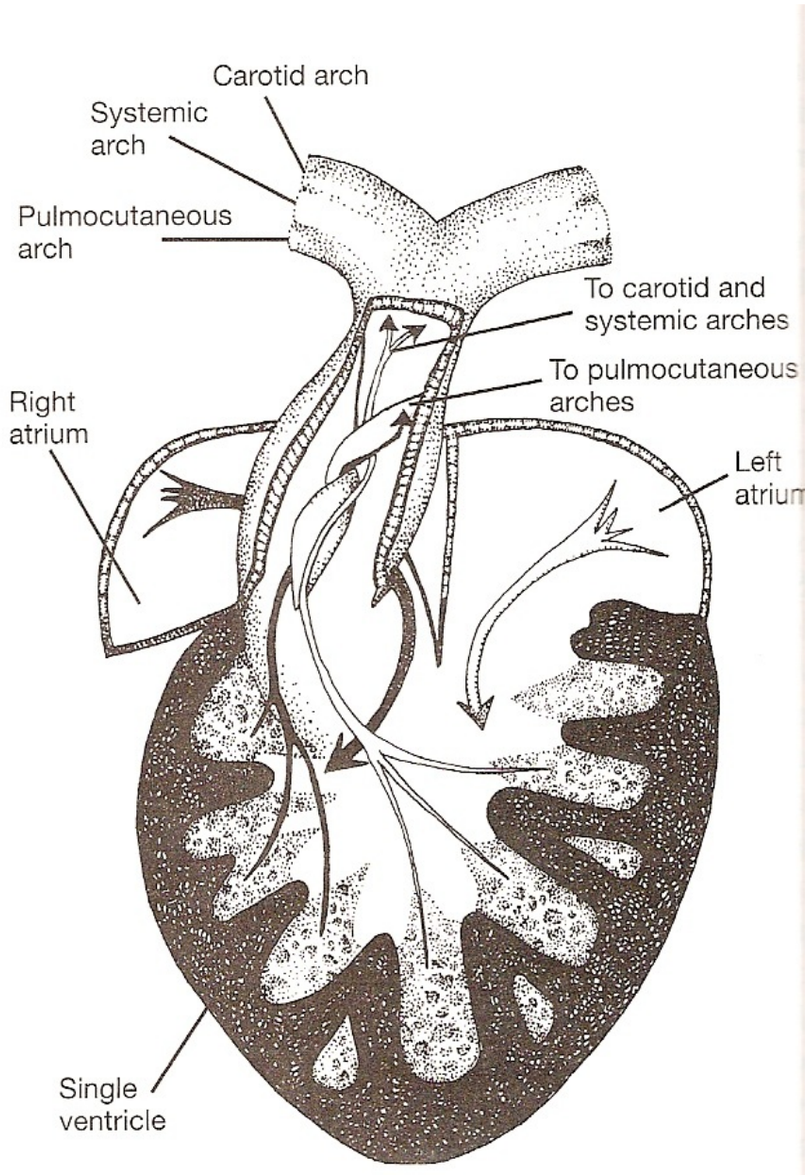
Circulation

- Amphibians with lungs: more complex



Blood Flow in the Heart

- Amphibians
  - Single ventricle
  - Complex internal structure
  - Trabeculae act to separate blood flow



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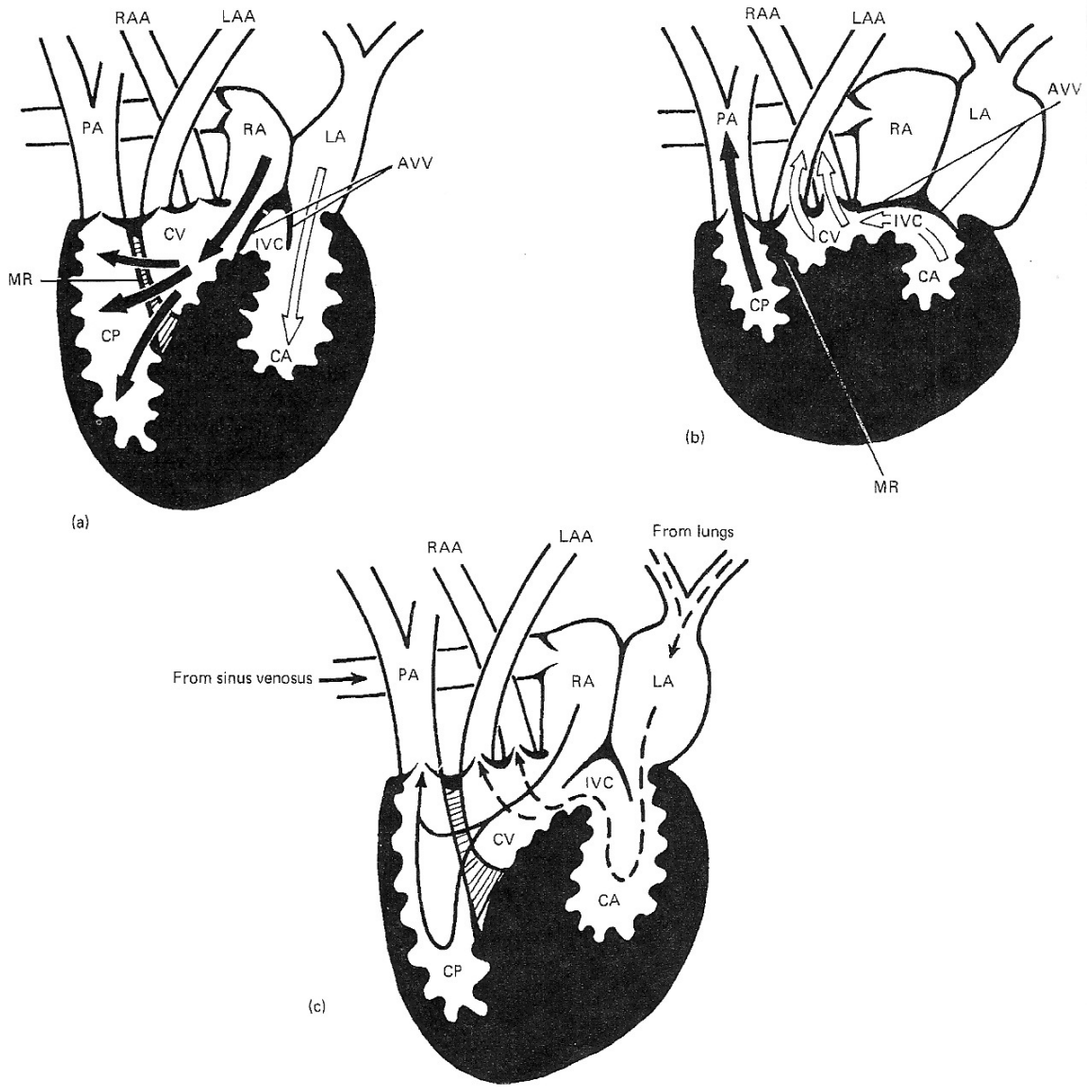
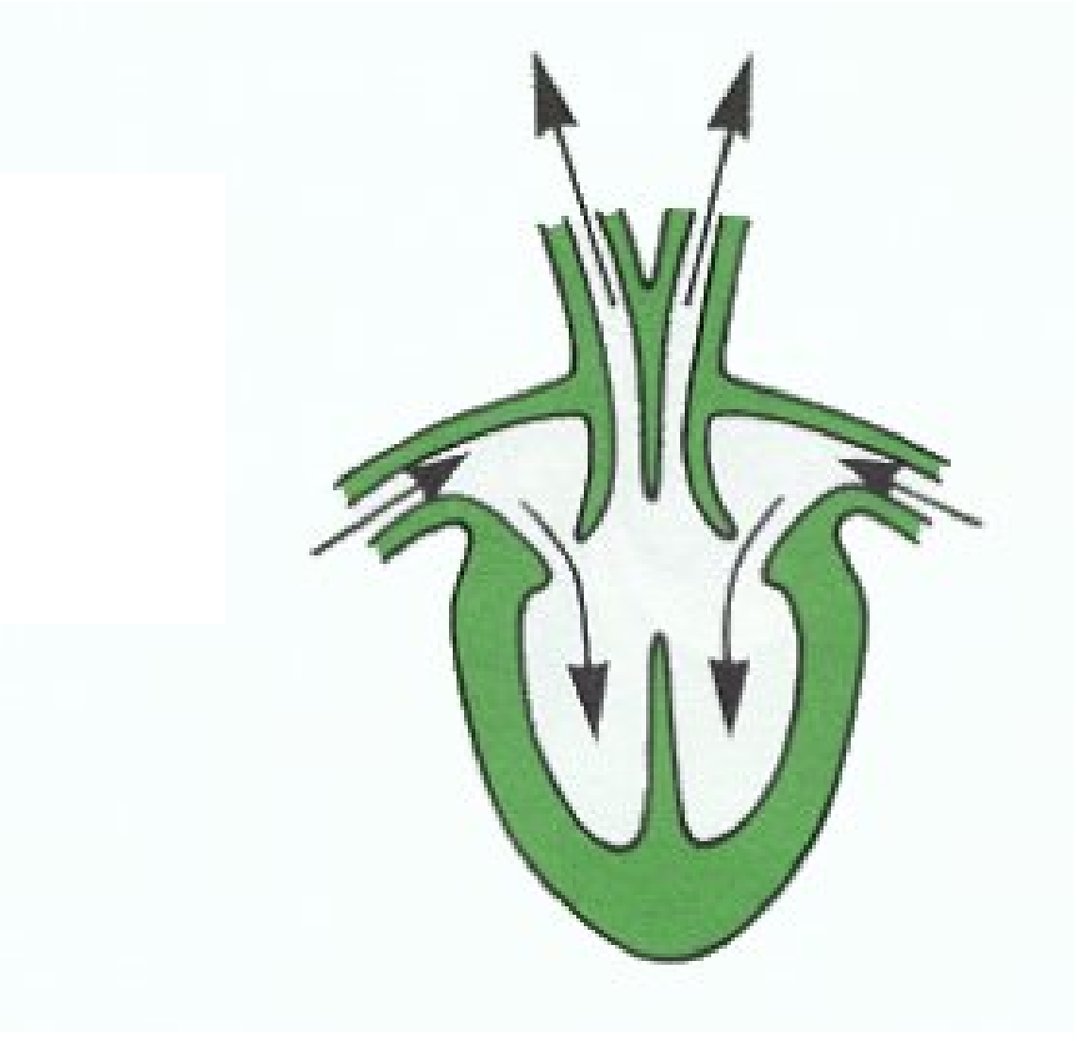
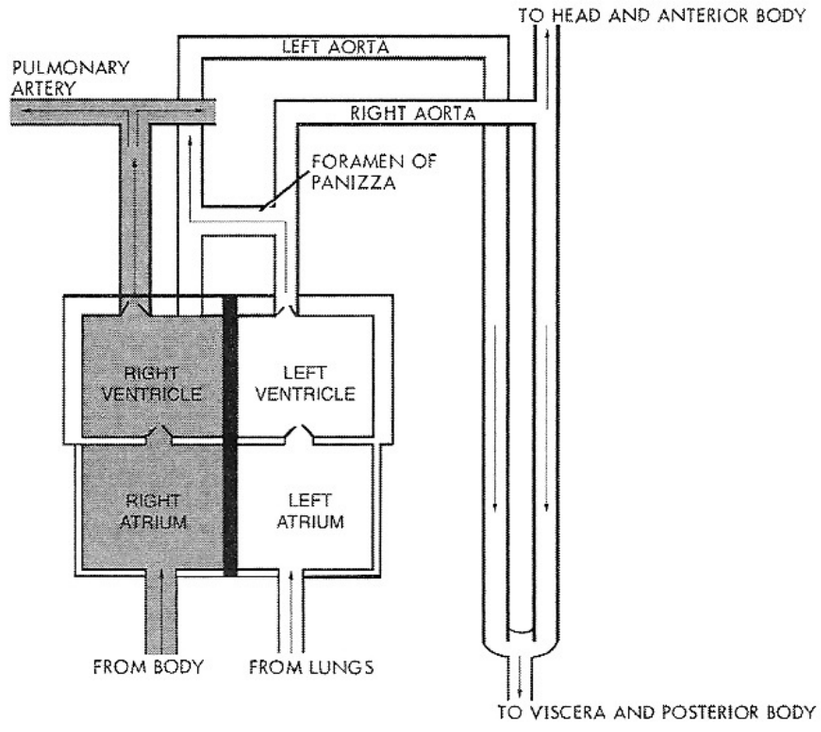


- Turtles and squamates

Blood Flow in the Heart





- Crocodilians

Intercardiac shunts

Three purposes:

1. Stabilize blood O_2
2. Thermoregulation
3. Bypass the lungs during breath holding